ABSTRACT

An apparatus and method for the direct reduction of iron oxide utilizes a hearth furnace having a vitreous hearth layer of conditioning materials, with the vitreous hearth layer introduced onto a refractory surface of the furnace. The vitreous hearth layer may have upper layers of coating compounds including carbonaceous materials, onto which iron oxide feed material is placed with the carbonaceous materials assisting with segregating the reduced molten iron nuggets from the vitreous hearth layer. The conditioning materials may include compounds such as silicon oxide, magnesium oxide, iron oxides, and aluminum oxide. The conditioning materials are placed in solid or liquid form on the refractory surface, which allows the conditioning materials to raise the melting temperature of the vitreous hearth layer onto which the coating compounds and iron oxide materials are placed. The iron oxide materials form molten metal nuggets of high purity iron and residual carbon, which remains separate from the vitreous hearth layer due to the layer of coating compounds. The invented apparatus and method of operation provide a solid iron and carbon product having high iron purity, which is discharged from the furnace without significant loss of iron onto the interior surfaces of the hearth furnace, and with limited buildup of hardened films of metallized iron product within the hearth